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ABSTRACT

Research is summarized in a brief final report built around a four-section bibliography. The first section lists periodic progress reports and articles which provide an overview of the program, including articles which pertain primarily to educational rather than technical aspects of satellite utilization. Theses carried out in the fields of electrical engineering, computer science, economics, and technology and human affairs comprise the second section, while the third part lists chronologically the CDT memoranda released in connection with the grant program. The final section contains technical articles. (SK)

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APPLICATION OF COMMUNICATIONS SATELLITES TO EDUCATIONAL DEVELOPMENT

FINAL TECHNICAL REPORT
SEPTEMBER 1, 1969 - AUGUST 31, 1975

NASA GRANT NO. NGR-26-008-054

Robert P. Morgan, Principal Investigator

Center for Development Technology
Washington University
St. Louis, Missouri 63130

APPLICATION OF COMMUNICATIONS SATELLITES TO EDUCATIONAL DEVELOPMENT

Final Technical Report
September 1, 1969 - August 31, 1975

NASA Grant No. NGR-26-008-054*

Robert P. Morgan, Principal Investigator

This brief final technical report represents a summary of research undertaken by the Center for Development Technology, Washington University on applications of communications satellites to educational development. The broad objectives of this NASA-supported interdisciplinary research effort, as stated in the original proposal to NASA, were 1) to assess the role of satellite communications as a means of improving education in the United States, as well as in less-developed areas of the world; 2) to generate basic knowledge which will aid in making rational decisions about satellite application in the field of education in the years ahead; 3) to devise systems and strategies for improving education; and 4) to educate individuals who will be knowledgeable about aspects of satellite communications policy which transcend any single discipline. The duration of the grant, which included a final, eight-month no-cost extension was from September 1, 1969 through August 31, 1975. Total funding over this six year period was $645,000.

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*The current NASA Technical Officer for the Grant is Wasyl Lew, User Support Officer (Code ECS), Applications Technology Satellites, Communication Programs, Office of Applications, National Aeronautics and Space Administration, Washington, D. C. 20546.

At the time this research effort was initiated, there was very little research in this field underway, either at universities or elsewhere. What has emerged is a series of documents which taken as a whole, provides a comprehensive base for considering future educational satellite utilization, with almost total focus on use within the United States. All the documents which were supported at least in part on this grant are listed in the bibliography in this report.

Rather than attempt a comprehensive summary of all research undertaken in the program, this final report will be built around the Bibliography which is divided into four sections. Section A, entitled Of General Interest, contains listings of periodic progress reports (Items A1 - A7), and articles which provide an overview of the program and educational satellite utilization in general (Items A8 - A20). It also contains a listing of published articles which pertain primarily to educational as opposed to technical aspects of satellite utilization. Item A3, which is available from ERIC and NTIS, provides a comprehensive overview of the first two years of the program. Items A11 and A12 perform a similar function as of early, 1972. Item A20 represents an initial attempt at identifying impacts of large-scale educational telecommunications systems, a subject in which additional work is desirable in the future.

Section B lists the theses which were carried out. Of these, two (B4 and B18) were PhD dissertations and the rest master's theses. Three of the latter (B8, B11 and B12) received no support from the NASA grant but are closely related to the field in question. Theses supported were in the fields of electrical engineering, computer science, economics, and technology and human affairs. Eight theses (B2, B3, B5, B7, B9, B13, B15, B16) were primarily technical in nature, focusing on such subjects

as micro-ave receiver design (B3, B5, B9) and communication satellite system analysis and optimization (B7, B15). Several others focused upon potential educational satellite system users (B6, B10, B14, B17).

Section C lists in order of their issuance, the CDT memoranda released in connection with the grant program. The memoranda proved to be a useful, rapid way to disseminate results. Memoranda topics can be roughly divided into three categories which were used as a means of organizing the project: 1) Needs Analysis (Items C1, C3, C4, C7, C8, C12, C13, C15, C18, C19, C21, C22, C23, C26); 2) Communications Technology Studies, (Items C9, C10, C11, C14, C16, C25); 3) Systems Synthesis (Items C2, C5, C6, C17, C20, C24, C27). Memorandum C26, "Large-Scale Educational Telecommunications Systems for the U.S.: An Analysis of Educational Needs and Technological Opportunities" represents a major program output. Memorandum C27, "Market Scenarios and Alternative Administrative Frameworks for U.S. Educational Satellite Systems" represents a pulling together of work in the systems synthesis area. Item C15 has been brought together in one volume entitled "Communications Technology for Education and Health Care Delivery in Appalachia." This work, although not supported by NASA, is listed because we believe that it was useful to the Appalachian Regional Commission in their participation in the ATS-6 satellite experiment and because it built upon expertise developed in the course of the NASA-sponsored research effort.

A final section, Section D, lists articles of primarily a technical nature which were published in connection with the NASA sponsored effort.

As with all research efforts, there is usually much that remains undone and new research opportunities to pursue in the future. This program is no exception. It was our original intention to synthesize

technical, economic and organizational factors to develop a set of educational satellite system alternatives. This effort, although partially attempted in several reports, (see in particular C27) was not completed. Many of the elements to perform such an analysis exist (see reports B7, B15, C2, C27). It seems likely that a related effort will be carried out by the Public Service Satellite Consortium with support from HEW. It was also hoped initially that some portion of our research could be devoted to educational satellite utilization vis-a-vis less developed countries. However, this was not possible because of the primary focus of the sponsoring agency on U.S. applications. We have just begun to scratch the surface in identifying and analyzing both short and long-term impacts of educational satellite applications (see A20). More direct interaction with potential "users" could have been undertaken.

Nevertheless, all things considered, the program output as reflected in the bibliography would seem to justify the support and confidence placed in the program by the sponsoring agency over the past six years. The general program objectives have been reasonably well met. The Needs Analysis document (C26) represents a comprehensive planning tool for large-scale educational telecommunications utilization with application to many technologies and users. Early program work stressed the importance of considering all possible media (e.g. CAI) and not just television in planning for educational satellite utilization. An educational satellite conference held in 1970 was helpful in defining and pushing forward with the ATS-6 satellite experiment. A study for the Appalachian Regional Commission (C15) helped ARC define their portion of that experiment. Project output ranged from a Delphi forecast for technology in education (B6) to hardware for a 12 GHz microwave

receiver (B9); from studies of educational production functions (C13) to cost analyses of various educational telecommunications networks (C5, C6, B15, B16); from studies of educational needs of various groups (B14, B17, C18, C19, C21) to computer models for satellite system analysis and optimization (B7, B13). Although various studies were undertaken to provide inputs to the needs analysis and systems synthesis efforts, the studies as written stand on their own. Breadth of coverage of topics is believed to be essential in considering socio-technological systems such as educational satellite networks.

Finally, I would like to personally acknowledge the efforts of those who contributed to the program effort: the faculty, students and staff of Washington University and particularly to Jai P. Singh, who served as co-principal investigator of the program from January, 1973 - November 1973, when he returned to India to work for the Indian Space Research Organization; and the several NASA officials who either monitored or otherwise interacted with this effort in various constructive ways. In general, we had much freedom to make our own mistakes and to learn from them. I hope that at a time when short-term contract research appears to be becoming the prevailing mode of doing business, future university-based research efforts will continue to enjoy the kind of freedom that we have had.

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